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Prussic Acid

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A. Dissertation
on the Medical and Physiological
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Of the various subjects which present themselves to our notice, none appears more deserving of attention, than that very powerful and singular chemical substance the Prussic Acid, and as little original matter can be expected from an individual, but as yet entering upon the mere threshold of his profession, I have preferred instituting a series of experiments, which might prove or invalidate the assertions of the celebrated Magendie, relative to the action of this substance on the animal economy.-

It will be seen that I have not digressed from the avowed object of this dissertation by framing theories or supporting hypotheses, formed perhaps in error and based upon conjecture, but that I have been content to yield the palm of ingenious speculation, to persons more fully acquainted with the principles of Physiology and medicine, that I have been just satisfied to pass over the path traced out before me by the superior industry and genius of the illustrious French Physiologist -

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the eighteenth century. and the acid itself owes its origin like very many important chemical discoveries to an unexpected and fortuitous circumstance. We are informed that Diesbach a colour maker of Berlin procured from his friend Dippel a quantity of potash which has been calcined with animal matter for the purpose of obtaining a red pigment from a combination of cochineal and iron, contrary to all expectation a blue precipitate was formed and in this we recognise the well known paint Prussian blue -

It would be superfluous to enter upon an examination of the many vague and ridiculous theories which were invented in order to account for the production of Prussian blue, suffice it to say, that it was on every side granted that all that was necessary to procure this substance was to expose animal matter, such as blood, in contact with the vegetable alkali to the action of a powerful heat for some hours in a crucible, afterwards to combine the new developed principle with some of the preparations of iron - Scheele by a process which I propose to detail, separated from this pigment an acid which is the subject

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of this dissertation, and which has derived the name of Prussic acid from the source from which it is most usually obtained -

Schrik mixed together in a state of fine powder, ten parts of Prussian blue, and five parts of red oxide of mercury, prepared by nitric acid, upon these he poured thirty parts of water, and exposed the mixture in a glass flask to a boiling temperature, the blue colour speedily disappeared, and the contents of the vessel assumed a greenish yellow, he boiled for a short time the substances upon each other, and when cool poured them on a filter, and examining the transparent fluid, which passed through he detected in it a certain principle which could not easily be referred to either of the individual substances which had been employed, but calling into view their reciprocal influence on each other, he arrived at the conclusion that the colouring principle of the Prussian blue had abandoned the iron, and had transferred itself to the mercury, a few simple experiments established the correctness of this reasoning, and pursuing the same train of induction, and subjecting his theory to the test of experiment, he obtained this very peculiar principle in a separate and independent form -

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We may be allowed, without giving this dissertation anything of the character of a chemical essay to follow up his process; to the limpid solution thus obtained, which we call Prussiate of Mercury, he added clean iron filings, and a small quantity of sulphuric acid, the iron filings were dissolved, the mercury of the solution resumed its metallic form, the colouring principle of the Prussic acid, is set free and with sulphate of iron is held in solution - the Prussic acid is volatile, the sulphate of iron fixed, heat is applied, and the acid combined with a quantity of water is distilled over -

This is a concise description, of the original process of obtaining Prussic acid, given with as little attention to the theory of its production as possible. Subsequent experiments of the same great Chemist, established the fact that this acid is not confined to any particular department of nature, but exists in the bitter almond, the peach leaf, and blossom, the Prunus Lauro Cerasus, and may be separated from all these vegetables by simple distillation, and may be even formed out of its component ingredients, by exposing a mixture of Potash charcoal and muriate of Ammonia, to an high temperature -

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The Prussic acid obtained in any of these ways had ever since its discovery borne the character of an active poison, but it remained for Gay Lussac the great French Chemist by a very refined process of Chemistry, to give this substance to the world in a more concentrated and consequently more active form, than it had ever before exhibited, this chemist imitates Scheele in separating the acid from the iron, and combining it with Mercury, but varies the process from this point very materially; he forms Muriatic acid upon Prussiate of Mercury in a small retort, and exposes them to the heat of a lamp, a long tube of small calibre is attached to the beak of the retort and small pieces of carbonate of lime are placed carelessly near its connection with the retort, the other extremity of the tube which passes into a receiver surrounded by ice, is also loosely filled with dry muriate of lime, on the application of heat to the retort, the muriatic acid seizes on the mercury, and expels the Prussic acid, which is driven over most generally combined with a small quantity of Muriatic acid and water, the marble in the near end of the tube absorbs the Muriatic acid - Prussic acid and water pass through the tube

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to the Muriate of lime, where the water is deposited, a moderate heat is applied, to the tube, which volatilizes the Prussic acid, which passes over and is condensed in the cold receiver; thus prepared Prussic acid, is a most terrifying and life destroying agent, and in this form has never been prescribed as a remedy. But of the different modes of procuring this acid for medical purposes, we must give a decided preference to that proposed and practised by M. Vauquelin, it stands eminently superior to Scheele's preparation, being more uniform in its strength and of course more certain in its effects. according to M. Vauquelin's process the Prussiate of Mercury is decomposed by sulphuretted hydrogen, and the acid is ultimately obtained by gentle distillation.

We have perhaps devoted too much of this paper to the Chemical consideration of the subject in question, but when we reflect that its own marked and particular influence upon the system is altogether dependent on its comparative genuineness and strength, and that it is more than probable that the failure of this article in the hands of many, is to be attributed to some deficiency in its Chemical

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composition, when all these circumstances are taken into view, we feel confident that the little we have said about its chemical preparation, will neither be regarded tedious or irrelevant.

Having completed the chemical history of this substance, we shall proceed to consider it in its most interesting point of view. namely as a medical agent, exercising power superior to, and essentially different from every other substance with which we are at all acquainted.

Many years have elapsed since the attention of the faculty was invited by a case of poisoning by Laurel water, which occurred in London, it was long known that bitter almonds killed dogs, and that certain birds, which eat with impunity the berries of the Laurel, were themselves poisonous at particular seasons, the case of poisoning by Laurel water, before adverted to, excited a spirit of enquiry into the nature and extent of such poisons, and Cullen remarks that the substances which afford this principle if swallowed in sufficient quantity extinguish life without producing the spasmodic phenomena which almost universally attend the dissolution of animals, and what is more extraordinary not a trace of its action, not a vestige of its influence can be

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perceived upon the stomach — the viscera to which it is most generally applied, and from which it must have diffused its action over the system — these circumstances, were it is true, treasured up in the recollections of medical men and were noticed in the Materia Medica, but all the peculiarities as applied to the treatment of disease, appear to have been overlooked, and at this moment all its efficacious properties might have slumbered in secret neglect, had we not been aroused to its consideration by the very astonishing and decisive physiological experiments of M. Magendie and his associates —

No one abhors barbarity or exclaims more vehemently against cruelty to animals than the writer of this essay, but at the same time he cannot but condemn the false feeling and mock humanity of some Modern Pythagoreans, who deplore with uplifted eyes and doleful lamentations the awful massacre of the canine race — from these preliminary observations it may be inferred that the author's pen is dipped in the blood of slaughtered dogs — it is true, and he does not wish to conceal it, but that a few have yielded up their lives in the cause of science, and

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that some have been immolated on the altar of experiment, it would be entirely out of place to enter upon a vindication of such experiments when the utility of them is so apparent, and the advantages so evident in relation to the subject before us –

The poisonous character of Prussic acid has long since been acknowledged and the numerous cases of immediate death by subtle poisoning may with great justice be attributed to the employment of Prussic acid or some of its compounds – this opinion is fully corroborated by the experiments of Coullon, Orfila, Pougnatelli and Magendie, these celebrated men have shewn that when Prussic acid is administered to hot blooded animals in its concentrated state, it destroys the irritability and contractability of their voluntary muscles, the few experiments which I have had an opportunity of making with the concentrated acid fully confirm those of Dr Magendie –

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to Gay Lussac's process by Dr. Cullen of this city were introduced into the posterior fauces of a good sized dog - the effect was more astonishing and instantaneous than had been even anticipated from Dr. Magendie's description of its powers, the animal fell on the floor, and expired without a single convulsion - A few drops of the acid were thrown upon the eye of a cat, and the effect was as sudden and complete as in the former experiment - A rabbit died almost immediately from the puncture of a lancet imbued with the acid -

I intended to multiply these experiments and at the suggestion of Dr. Cullen I purposed to ascertain by direct experiments, if the animal was susceptible of galvanic excitement or not, I however improvidently deferred my experiments a day or so, and when I wished to resume my operations, the acid, which had at this time been made above three days, was entirely decomposed: possessing very little skill in the manipulations of Chemistry I again applied to Dr. Cullen for an additional quantity of the acid, but I could not

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Presuming on the repetition of these experiments I importunately overlooked some of the leading Physiological phenomena produced by the acid, and I did not with any certainty determine, whether, according to Magendie the animal retained life for any period at the expense of its external functions - Dr. Magendie in studying the phenomena of poisoning by Prussic acid, observed that animals on which it had been made to act in more moderate doses, and in whom no traces of sensibility or muscular contraction could be found, would often continue to breathe for several hours freely, while the circulation remained scarce altered, indeed, says Magendie it might be said that these animals were dead with regard to their external functions, yet still enjoyed life through their nutritive faculties - This power of allaying general sensibility without any apparent injury to the respiration or circulation induced the belief that this acid might be usefully employed in diseases of great irritation and excessive sensibility -

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These opinions deduced from observing the effects of the acid on animals, soon led to its use in the treatment of spasmodic affections, where local irritation would excite by sympathy constitutional affections.

As might be expected it has been found particularly useful in spasmodic coughs, asthma, in those cases of Phthisis where the patients is only debilitated by repeated bleeding and the use of other depletives, but before we enter into a detail of the many diseases in which it is found highly serviceable, we should first enquire, under what class of remedies it is to be ranked, and we will attempt to assign some more specific character than we have as yet bestowed upon it.

That it is a narcotic no one will hesitate to allow, but that it is distinguished from every other article of that class of substances, simply requires an examination of its powers. We perceive a material difference in its operation from sedatives in general, it does not even in small doses excite those exhilarating effects which are universally ascribed to opium, it is true that by subduing pain it produces tranquillity of mind, by soothing the patients sufferings it excites cheerfulness

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and comfort, it charms away agony and banishes despair but in producing these effects, it operates very differently indeed from opium and other narcotics, they stimulate in the first instance, and excite the sensorium in an unusual manner, they exercise a very marked influence over the sanguineous, and other systems of the body, in fine, there are but few points of resemblance, few assimilating traits by which we can identify them with each other.

It would be trespassing beyond the proposed extent of this essay to enter upon an examination of all the remarkable properties of this active substance, we will content ourselves with a mere recital of the diseases in which it has been employed with advantage. It may not be unimportant to remark that the evidence in favour of its use is of the most respectable kind, derived from some of the most eminent practitioners of the continent of Europe and Great Britain - reference to Magendie's memoir, at one view gives us the history of its application to several cases of Phthisis and Drs Manzoni and Borda of Italy bear ample testimony of its successful employment in consumptive cases and Dr. Granville

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and Sendamore and some other distinguished Physicians, declare it to be, beyond all comparison, the most valuable remedy that has ever been made use of in the treatment of Phthisis and certain other complaints -

The medical world is justly sceptical with regard to the powers of new medicines and when we consider the high, but ephemeral reputation, of some articles of the materia medica we are warranted in receiving with great caution the reports of individuals, perhaps carried away by false zeal and enthusiasm -

Dr. Granville who has had more experience, than the other English Practitioners, in the use of this article, thus expresses himself with regard to its action on a patient exhausted by disease or the previous medical treatment, says he "it exerts an immediate influence on the nervous system, it gradually diminishes all irritability, checks the rapid circulation, and calms many of the symptoms of fever - if a dry cough is present it promotes expectoration in the first instance, and subsequently stops the cough itself: the spirits before exalted soon feel the quieting impression of the acid,

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they become subdued, the speech, the countenance, even the expression of the eyes, assume the character of unusual meekness - there is a relief from pain and actual suffering, but he tells us, that in some few cases the sedative effects are much more considerable, that there is in some instances, an apparent entire prostration of strength, great lowness of spirits and unwillingness to move, speak, or take food, life seems suspended and indeed the patient expresses that he feels himself as if only half alive - yet the head and mind remain clear and intelligent, there is a total absence of pain, the heat of the skin is natural, and the pulse continues its course steadily and quietly - after some hours the system returns to its original condition -

From what has been said of the operation of this article, it must appear, that we cannot limit its application to any particular disease, but that its use is as extensive as the indications of morbid irritability - I have had myself no experience with this acid, but Dr. Cullen informs me, that a fit subject fell under his notice, whom he treated as directed by Magendie - the case was however desperate - disorganization of the lungs had commenced and a

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palliative system of treatment was alone pointed out; the Prussic acid answered every object in view and corresponded exactly with the histories of Magendie and Granville, the patient, it is true, died, but he expressed great gratitude for the mitigation of his sufferings - the acid was prepared according to Vauquelin's process and two drops, dissolved in a table spoonful of mucilage, were at first given twice a day, but gradually increased to sixteen in the twenty four hours -

There is perhaps no theme, which involves more weighty considerations, than the subject I have so imperfectly noticed - if the ability of doing it justice existed, the short period which has passed since the attention of the writer was excited by the notice and corresponding remarks of Professor Chapman, relative to the action of Prussic acid - I have not only been precluded from rendering this essay, worthy the attention of the Faculty by shortness of time, but also from the want of the necessary opportunities of making practical inquiries - but I feel confident that I have distinctly proved that this is not the effete and worthless preparation which its conducts experiments and premature

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opinion would induce us to suppose it – Throwing this dissertation, with all its imperfections, upon the mercy of judges, more disposed to commend than to censure, it but remains for me to declare, that if this essay meets the approbation of the illustrious body to whom it is submitted, then I shall be, not only, more than compensated for any pains it may have cost me, but that I shall consider myself stimulated to further exertion and unceasing diligence.

Edward D. Coffin Mass

admitted March 20th 1860